SPECIFICATION WITH MARKED AMENDMENTS

Fireproof glazing unit

Description:

The invention relates to a fireproof glazing unit consisting of at least two transparent substrates arranged at a certain distance from each other, whereby there is at least one transparent fireproof layer between the substrates.

In order to configure transparent glazing units as fireproof glazing, it is a known procedure to employ laminated glass that has at least one transparent fireproof layer. The effect of such a fireproof layer can be, for instance, that in case of fire, it expands to create a hardening foam that consequently forms a shield against the heat generated by the fire. However, most of the familiar fireproof systems have the drawback that the fireproof layers used are not UV-stable. As a consequence, exposure to sunlight over a prolonged period of time causes the fireproof layer to become cloudy, a phenomenon that greatly impairs the appearance of the glazing. This is particularly disadvantageous when fireproof glazing is used in residential, office or other public areas, where the visual appearance of glass panes is of great importance.

In order to reduce the UV sensitivity of fireproof layers, it is a known procedure to employ various additives in the production of the layers. For instance, German Preliminary Published Application DE 44 35 841 proposes the use of potash water glass as an additive for the fireproof layer between two glass panes. Here, the amount of the additive consisting of potash water glass is selected in such a way that, as a function of the prevailing conditions, a detrimental sensitivity to ultraviolet light no longer exists. The main components of the described fireproof layer are soda water glass and water, whereas organic additives in the form of polyvalent alcohols and/or sugars constitute minute residues.

The disadvantage of stabilized protective layers lies in the fact that the production of fireproof layers is always associated with a great deal of effort in view of the process involved. For example, the necessary potassium water glass component has to be precisely determined and adjusted to any changes in the composition of the layer. Moreover, the processes can only be employed for one type of fireproof layer, while other forms require adapted additives or even different solutions.

International patent application WO 99/35102 and the corresponding Japanese patent application JP 111 99 278 disclose a UV-absorbing fireproof glazing in which, in front of a fireproof layer that foams in case of fire, there is a UV-absorbing layer containing the amide compounds of an aminosilane compound that reacts with a UV-absorbing compound. Even though this method is suitable for different fireproof layers, it is very demanding.

Therefore, the objective of the invention is to provide fireproof glazing that is simple to produce and that has at least one transparent fireproof layer exhibiting a high level of UV stability.

According to the invention, this objective is achieved in that a fireproof glazing unit – consisting of at least two transparent substrates arranged at a certain distance from each other, whereby there is at least one transparent fireproof layer between these substrates – is configured in such a way that there is a transparent TiO_2 layer that reduces the incidence of UV radiation onto the fireproof layer on at least one side of said layer.

In order to absorb the UV radiation of the incident sunlight and to reduce it for the fireproof layer that lies behind the TiO_2 layer, the latter is advantageously located on the side of the fireproof layer that faces outwards.

It has proven to be advantageous to configure the fireproof glazing unit in such a manner that the fireproof layer displays an absorption of at least 70% within the wavelength spectrum from 800 nm to 1400 nm. This prevents heat from penetrating the spaces that are to be protected.

It is also advantageous to configure the fireproof glazing unit in such a way that the TiO_2 layer displays an absorption between 3% and 15% within the wavelength spectrum from 320 nm to 480 nm. In this manner, damage to the fireproof layer by UV radiation can be largely prevented.

In order to further increase the stability of the fireproof layer contained in the fireproof glazing unit, it is practical to configure the TiO_2 layer in such a way that it exhibits a reflection of at least 40% within the wavelength spectrum from 320 nm to 480 nm.

An especially preferred embodiment of the fireproof glazing unit is characterized in that the TiO_2 layer displays a reflection of 40% to 60% within the wavelength spectrum from 320 nm to 480 nm.

In an advantageous embodiment of the invention, the UV-absorbing TiO_2 layer is located on the surface of a glass pane of the glazing unit facing outwards. In another particularly preferred embodiment, the UV-absorbing TiO_2 layer is located between the inner surface of the glass pane facing outwards and the fireproof layer. In addition to glass panes arranged at a certain distance from each other and the fireproof layer, the fireproof glazing unit can also comprise other functional layers. Examples of these are fluorine-doped SnO_2 layers for IR reflection. In the case of several functional layers between the outer glass pane and the fireproof layer, the TiO_2 layer can also be arranged between the various layers. The arrangement of the layer is preferably selected in such a manner that the function of the surrounding layers is not impaired by the reduction of the incident UV radiation.

Layers containing TiO_2 components are normally employed to create an auto-catalytic effect on surfaces. This effect serves to protect the surface against the effects of weather and dirt. The UV-absorbing properties of TiO_2, however, give rise to surprising advantages when used in fireproof glazing. These advantages include, in particular, the fact that the TiO_2 layers according to the invention can be applied by means of just a few processing steps and with different methods. Moreover, the arrangement of the layer inside the fireproof glass unit can be selected as a function of the requirements. It is also advantageous that UV stability can be attained irrespective of the type of fireproof layer. Consequently, the layer structure according to the invention can be employed for different fireproof layers.

Additional advantages, special features and practical refinements of the invention can be gleaned from the subordinate claims and from the presentation below of preferred embodiments making reference to the figures.

The figures show the following:

Figure 1 – a particularly preferred embodiment of a fireproof glass unit having a TiO_2 layer between an outer glass pane and a fireproof layer; and

Figure 2 – an embodiment of a fireproof glass unit having a TiO_2 layer on the outer surface of a glass pane.

The depiction in Figure 1 shows an especially preferred embodiment of the structure according to the invention of a fireproof glazing unit having a TiO_2 layer. The fireproof glazing unit consists of at least two transparent glass substrates (10; 20) that are positioned at a certain distance from each other, and of at least one likewise transparent fireproof layer (30) that is located between the glass substrates.

The glass panes employed can be conventional panes used in the manufacture of transparent fireproof glazing.

The fireproof layer (30) can be formed in different ways. For instance, known hydrogels can be used whose main component is water with admixtures of salts and stabilizing polymers. Here, the stabilizing polymers serve as gel-forming agents. One can also use fireproof mixtures that contain water bonded to water glass, at least one cellulose derivative and, advantageously, preservatives. The preservative can be, for example, selected from among the group consisting of copper sulfate, copper acetate, benzoic acid or mixtures thereof.

Sol-gel techniques, gel casting-resin methods and/or pouring methods can all be employed in order to produce the fireproof layer. Pouring methods make use, for instance, of aqueous alkali-silicate solutions, preferably with admixtures, which are then poured onto a horizontal glass pane. The water of the solution is removed by means of drying procedures, so that the layer hardens to form a solid fireproof layer.

Such fireproof layers typically display absorption levels ranging from 4% to 15% of the UV-A radiation found in sunlight. Starting at an absorption level of about 4%, however, UV stability is no longer ensured. The structure according to the invention of the fireproof glazing with a transparent TiO_2 layer (30) brings about a reduction of the incident UV radiation in the order of magnitude of 80%, so that the UV radiation absorbed by the fireproof layer arranged behind the TiO_2 layer does not exceed a value of about 4% of the total incident UV radiation.

In the embodiment depicted in Figure 1, the TiO_2 layer is located between the outer glass pane (10) and the fireproof layer (30). Additional functional layers (50) can be arranged between these two layers~~, even though this is not shown here~~. For instance, fluorine-doped SnO_2 layers can be used in order to attain additional IR reflection. In the case of several functional layers, the TiO_2 layer can

be suitably installed between different layers. When the layer structure is selected, it is definitely advantageously if the function of the layers is not detrimentally affected by the UV reduction.

In a particularly preferred embodiment of the invention, the thickness of the TiO_2 layer lies in the order of magnitude from 10 nm to 75 nm. It has been found that the relevant UV protection starts at a layer thickness of 10 nm, whereby the maximum layer thicknesses should not exceed 75 nm since otherwise, the transparency of the glass unit would be insufficient. Therefore, when it comes to optimizing the structure, it has been found to be advantageous to utilize especially layer thicknesses from 20 nm to 30 nm.

The TiO_2 layers can be applied by means of various methods. For example, TiO_2 can be applied by the magnetron sputtering method, which is preferably carried out reactively here with a ceramic target. Moreover, sol-gel methods and CVD methods are good options in this context.

Figure 2 shows another especially preferred embodiment of the invention in which the transparent TiO_2 layer is located on the outer surface of the glass pane facing outwards.

List of reference numerals

10	outer glass pane
11	outer surface of the outer glass pane
12	inner surface of the outer glass pane
20	inner glass pane
30	fireproof layer
40	TiO_2 layer
50	additional functional layer

SPECIFICATION: CLEAN VERSION (WITHOUT MARKINGS)

Fireproof glazing unit

Description:

The invention relates to a fireproof glazing unit consisting of at least two transparent substrates arranged at a certain distance from each other, whereby there is at least one transparent fireproof layer between the substrates.

In order to configure transparent glazing units as fireproof glazing, it is a known procedure to employ laminated glass that has at least one transparent fireproof layer. The effect of such a fireproof layer can be, for instance, that in case of fire, it expands to create a hardening foam that consequently forms a shield against the heat generated by the fire. However, most of the familiar fireproof systems have the drawback that the fireproof layers used are not UV-stable. As a consequence, exposure to sunlight over a prolonged period of time causes the fireproof layer to become cloudy, a phenomenon that greatly impairs the appearance of the glazing. This is particularly disadvantageous when fireproof glazing is used in residential, office or other public areas, where the visual appearance of glass panes is of great importance.

In order to reduce the UV sensitivity of fireproof layers, it is a known procedure to employ various additives in the production of the layers. For instance, German Preliminary Published Application DE 44 35 841 proposes the use of potash water glass as an additive for the fireproof layer between two glass panes. Here, the amount of the additive consisting of potash water glass is selected in such a way that, as a function of the prevailing conditions, a detrimental sensitivity to ultraviolet light no longer exists. The main components of the described fireproof layer are soda water glass and water, whereas organic additives in the form of polyvalent alcohols and/or sugars constitute minute residues.

The disadvantage of stabilized protective layers lies in the fact that the production of fireproof layers is always associated with a great deal of effort in view of the process involved. For example, the necessary potassium water glass component has to be precisely determined and adjusted to any changes in the composition of the layer. Moreover, the processes can only be employed for one type of fireproof layer, while other forms require adapted additives or even different solutions.

International patent application WO 99/35102 and the corresponding Japanese patent application JP 111 99 278 disclose a UV-absorbing fireproof glazing in which, in front of a fireproof layer that foams in case of fire, there is a UV-absorbing layer containing the amide compounds of an aminosilane compound that reacts with a UV-absorbing compound. Even though this method is suitable for different fireproof layers, it is very demanding.

Therefore, the objective of the invention is to provide fireproof glazing that is simple to produce and that has at least one transparent fireproof layer exhibiting a high level of UV stability.

According to the invention, this objective is achieved in that a fireproof glazing unit – consisting of at least two transparent substrates arranged at a certain distance from each other, whereby there is at least one transparent fireproof layer between these substrates – is configured in such a way that there is a transparent TiO_2 layer that reduces the incidence of UV radiation onto the fireproof layer on at least one side of said layer.

In order to absorb the UV radiation of the incident sunlight and to reduce it for the fireproof layer that lies behind the TiO_2 layer, the latter is advantageously located on the side of the fireproof layer that faces outwards.

It has proven to be advantageous to configure the fireproof glazing unit in such a manner that the fireproof layer displays an absorption of at least 70% within the wavelength spectrum from 800 nm to 1400 nm. This prevents heat from penetrating the spaces that are to be protected.

It is also advantageous to configure the fireproof glazing unit in such a way that the TiO_2 layer displays an absorption between 3% and 15% within the wavelength spectrum from 320 nm to 480 nm. In this manner, damage to the fireproof layer by UV radiation can be largely prevented.

In order to further increase the stability of the fireproof layer contained in the fireproof glazing unit, it is practical to configure the TiO_2 layer in such a way that it exhibits a reflection of at least 40% within the wavelength spectrum from 320 nm to 480 nm.

An especially preferred embodiment of the fireproof glazing unit is characterized in that the TiO_2 layer displays a reflection of 40% to 60% within the wavelength spectrum from 320 nm to 480 nm.

In an advantageous embodiment of the invention, the UV-absorbing TiO_2 layer is located on the surface of a glass pane of the glazing unit facing outwards. In another particularly preferred embodiment, the UV-absorbing TiO_2 layer is located between the inner surface of the glass pane facing outwards and the fireproof layer. In addition to glass panes arranged at a certain distance from each other and the fireproof layer, the fireproof glazing unit can also comprise other functional layers. Examples of these are fluorine-doped SnO_2 layers for IR reflection. In the case of several functional layers between the outer glass pane and the fireproof layer, the TiO_2 layer can also be arranged between the various layers. The arrangement of the layer is preferably selected in such a manner that the function of the surrounding layers is not impaired by the reduction of the incident UV radiation.

Layers containing TiO_2 components are normally employed to create an auto-catalytic effect on surfaces. This effect serves to protect the surface against the effects of weather and dirt. The UV-absorbing properties of TiO_2, however, give rise to surprising advantages when used in fireproof glazing. These advantages include, in particular, the fact that the TiO_2 layers according to the invention can be applied by means of just a few processing steps and with different methods. Moreover, the arrangement of the layer inside the fireproof glass unit can be selected as a function of the requirements. It is also advantageous that UV stability can be attained irrespective of the type of fireproof layer. Consequently, the layer structure according to the invention can be employed for different fireproof layers.

Additional advantages, special features and practical refinements of the invention can be gleaned from the subordinate claims and from the presentation below of preferred embodiments making reference to the figures.

The figures show the following:

Figure 1 – a particularly preferred embodiment of a fireproof glass unit having a TiO_2 layer between an outer glass pane and a fireproof layer; and

Figure 2 – an embodiment of a fireproof glass unit having a TiO_2 layer on the outer surface of a glass pane.

The depiction in Figure 1 shows an especially preferred embodiment of the structure according to the invention of a fireproof glazing unit having a TiO_2 layer. The fireproof glazing unit consists of at least two transparent glass substrates (10; 20) that are positioned at a certain distance from each other, and of at least one likewise transparent fireproof layer (30) that is located between the glass substrates.

The glass panes employed can be conventional panes used in the manufacture of transparent fireproof glazing.

The fireproof layer (30) can be formed in different ways. For instance, known hydrogels can be used whose main component is water with admixtures of salts and stabilizing polymers. Here, the stabilizing polymers serve as gel-forming agents. One can also use fireproof mixtures that contain water bonded to water glass, at least one cellulose derivative and, advantageously, preservatives. The preservative can be, for example, selected from among the group consisting of copper sulfate, copper acetate, benzoic acid or mixtures thereof.

Sol-gel techniques, gel casting-resin methods and/or pouring methods can all be employed in order to produce the fireproof layer. Pouring methods make use, for instance, of aqueous alkali-silicate solutions, preferably with admixtures, which are then poured onto a horizontal glass pane. The water of the solution is removed by means of drying procedures, so that the layer hardens to form a solid fireproof layer.

Such fireproof layers typically display absorption levels ranging from 4% to 15% of the UV-A radiation found in sunlight. Starting at an absorption level of about 4%, however, UV stability is no longer ensured. The structure according to the invention of the fireproof glazing with a transparent TiO_2 layer (30) brings about a reduction of the incident UV radiation in the order of magnitude of 80%, so that the UV radiation absorbed by the fireproof layer arranged behind the TiO_2 layer does not exceed a value of about 4% of the total incident UV radiation.

In the embodiment depicted in Figure 1, the TiO_2 layer is located between the outer glass pane (10) and the fireproof layer (30). Additional functional layers (50) can be arranged between these two layers. For instance, fluorine-doped SnO_2 layers can be used in order to attain additional IR reflection. In the case of several functional layers, the TiO_2 layer can be suitably installed between different layers.

When the layer structure is selected, it is definitely advantageously if the function of the layers is not detrimentally affected by the UV reduction.

In a particularly preferred embodiment of the invention, the thickness of the TiO_2 layer lies in the order of magnitude from 10 nm to 75 nm. It has been found that the relevant UV protection starts at a layer thickness of 10 nm, whereby the maximum layer thicknesses should not exceed 75 nm since otherwise, the transparency of the glass unit would be insufficient. Therefore, when it comes to optimizing the structure, it has been found to be advantageous to utilize especially layer thicknesses from 20 nm to 30 nm.

The TiO_2 layers can be applied by means of various methods. For example, TiO_2 can be applied by the magnetron sputtering method, which is preferably carried out reactively here with a ceramic target. Moreover, sol-gel methods and CVD methods are good options in this context.

Figure 2 shows another especially preferred embodiment of the invention in which the transparent TiO_2 layer is located on the outer surface of the glass pane facing outwards.

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11	outer surface of the outer glass pane
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50	additional functional layer